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6.6 PALEONTOLOGICAL RESOURCES

6.6.1 Introduction

This SPPE Application is for the construction and operation of the ECGS Unit 3 Repower Project. The Project will be owned and operated by IID ("the Applicant") and will utilize the existing staffing at the ECGS. IID is an irrigation district established under Division 11 of the California water code, Sections 20500 et seq., that provides electrical power, non-potable water, and farm drainage services to the lower southeastern portion of the California desert, primarily in Imperial County. The ECGS Site will continue to serve the growing electrical load demands of the region.

The Project consists of replacing the existing CE boiler with a GE Frame 7EA dry low NO_x CTG and HRSG to supply steam to the existing Westinghouse STG. The generator output from the Unit 3 Repower Project will be stepped-up to transmission voltage and interconnected to the existing IID El Centro Switching Station also located within the ECGS Site.

Most of the existing ECGS systems will continue to be used with only minor modifications. Systems that will continue to be used include the STG, cooling system, water treatment system, water supply system, control room, fire system, ammonia system, site access during operations, and electrical El Centro Switching Station.

The Project consists of two major project areas:

- Project Site – new Unit 3 CTG/HRSG, minor modifications to the existing Unit 3 cooling tower, replacement of the Unit 3 condenser, minor modifications to Unit 3 STG, the 92 kV electrical interconnection and modifications to the existing gas interconnection facilities.
- Temporary Construction Area – construction parking, construction trailers, and construction laydown area.

The total Project disturbance will be 12.5 acres, all of which is within the ECGS Site.

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. Fossils are important scientific and educational resources because of their use in (1) documenting the presence and evolutionary history of particular groups of now extinct organisms, (2) reconstructing the environments in which those organisms lived, and (3) in determining the relative ages of the strata in which they occur and of the geologic events that resulted in the deposition of the sediments that buried them.

This section of the SPPE summarizes the potential environmental impacts on paleontological resources that may result from the Project. Section 6.6.2, Laws, Ordinances, Regulations, and Standards, lists the federal, state, and county LORS and the professional standards that protect paleontological resources. Section 6.6.3, Affected Environment, describes the existing environment that could be affected by the Project. Resource inventory methods and results are discussed in Section 6.6.4, Resource Inventory Methods, and Section 6.6.5, Resource Inventory Results, respectively. Section 6.6.6, Impacts, describes the potential impacts on paleontological resources resulting from construction and operation of the Project. Mitigation measures to reduce potential adverse impacts to paleontological resources are discussed in Section 6.6.7, Mitigation. Unavoidable adverse impacts are discussed in Section 6.6.8, Significant

Unavoidable Adverse Impacts. The cumulative impacts to paleontological resources are discussed in Section 6.6.9, Cumulative Impacts. The involved agencies and agency contacts are provided in Section 6.6.10, Involved Agencies and Agency Contacts. Section 6.6.11, Permits Required and Permit Schedule, discusses the status of permits required and permit schedule. Section 6.6.12, References Cited, lists the references used in preparing this document.

This paleontological resource impact assessment was prepared by Lanny H. Fisk, PhD, PG, a California registered Professional Geologist (PG) and Senior Paleontologist with PaleoResource Consultants (PRC). It meets all requirements of the CEC (2000) and the standard measures for mitigating adverse construction-related environmental impacts on significant paleontological resources established by the Society of Vertebrate Paleontology (SVP) (SVP 1995, 1996).

Appendix M, Paleontological Technical Report, provides a complete review of the paleontological resources of this Project.

6.6.2 Laws, Ordinances, Regulations, and Standards

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes (California State Historic Preservation Office 1983; Marshall 1976; West 1991; Fisk and Spencer 1994; Gastaldo 1999), most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies and by the State of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established by the SVP (1995, 1996). Design, construction, and operation of the Project, including ancillary facilities, will be conducted in accordance with LORS applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 6.6-1, LORS Applicable to Paleontological Resources, and discussed briefly below, together with SVP professional standards.

TABLE 6.6-1
LORS APPLICABLE TO PALEONTOLOGICAL RESOURCES

Project LORS	Applicability	SPPE Reference	Conformity
Antiquities Act of 1906	Protects paleontological resources on federal lands	Section 6.6.2.1, Federal LORS	Yes
CEQA	Fossil remains may be encountered by earth-moving	Section 6.6.2.1, Federal LORS	Yes
Public Resources Code Sections 5097.5/5097.9	Would apply only if project impacts occurred on lands either owned or managed by the State of California	Section 6.6.2.1, Federal LORS	Yes

Notes:
CEQA = California Environmental Quality Act
LORS = laws, ordinances, regulations, and standards
SPPE = Small Power Plant Exemption

6.6.2.1 Federal LORS

Federal protection for significant paleontological resources would apply to the Project if any construction or other related Project impacts occurred on federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of

1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal land.

6.6.2.2 State LORS

The CEC environmental review process required under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (CEQA; Public Resources Code Sections 15000 et seq.) with respect to paleontological resources. Guidelines for the implementation of CEQA (Title 14, Chapter 3, CCR: 15000 et seq.) define procedures, types of activities, persons, and public agencies required to comply with CEQA, and include as one of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section XIV, Part a) the following: "*Would the project directly or indirectly destroy a unique paleontological resource or site*?"

Other state requirements for paleontological resources management are in Public Resources Code Chapter 1.7, Section 5097.5, Archaeological, Paleontological, and Historical Sites. This statute specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources and defines any unauthorized disturbance or removal of a fossil site or remains on public land as a misdemeanor. It would apply to the ECGS Site only if any construction or other related project impacts occurred on state owned or managed lands or if the state or a state agency were to obtain ownership of Project lands during the term of the Project license.

6.6.2.3 County LORS

Imperial County does not have mitigation requirements that specifically address potential adverse impacts to paleontological resources. However, the Land Use Element of the Imperial County General Plan, which serves as the primary policy statement by the County Board of Supervisors for implementing development policies and land uses, contains Goals and Objectives statements that provide direction for private development and guidelines for land use decision making. These Goals and Objectives repeatedly mention preserving natural resources and the natural environment and avoiding adverse environmental impacts. Objective 8.8 specifically states that the siting of future facilities for the transmission of electricity should be compatible with the environment. Goal 9 deals with the protection of environmental resources and states that the county will identify and preserve significant natural, cultural, and community character resources. Objective 9.1 requires the preservation of important natural resources, including prehistoric sites.

6.6.2.4 Professional Standards

The SVP, an international scientific organization of professional paleontologists, has established standard guidelines (SVP 1995, 1996) that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys; monitoring and mitigation; data and fossil recovery; sampling procedures; and specimen preparation, identification, analysis, and curation. The SVPs standard guidelines were approved by a consensus of professional paleontologists and are the standard against which all paleontological monitoring and mitigation programs are judged. Most practicing professional paleontologists in the nation adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically spelled out in its standard guidelines. Most federal and California state regulatory agencies accept the SVP standard guidelines as a measure of professional practice.

6.6.3 Affected Environment

6.6.3.1 Geographic Location

The Project Site is in the northeastern portion of the City of El Centro in south-central Imperial County within the existing ECGS Site. The Project Site will be located adjacent to the existing Unit 3 boiler and to the existing steam turbine building at approximately 32°48'09"N latitude and 115°32'24"W longitude. The street address of the facility is 485 East Villa Avenue, El Centro, California. The 150-acre ECGS Site is generally located north of Commercial Avenue, west of Dogwood Road, south of East Villa Avenue, and east of Third Street. The Project Site has been completely cleared and leveled. Surface elevation is approximately 50 feet below sea level. The ECGS Site is located entirely within the USGS El Centro 7.5-minute (1:24,000 scale) Quadrangle.

The Project Site is located within the Salton Basin, which is divided by the Salton Sea into the Coachella Valley to the north and the Imperial Valley to the south. The Imperial Valley comprises roughly the southern two thirds of a major north-northwest oriented structural and topographic depression variously called the Valley of the Ancient Lake (Blake 1858), the Colorado Desert (Stearns 1879; Preston 1893; Fenneman 1931), Salton Trough (Jahns 1954; Muffler and White 1969; Crowell and Baca 1979; Waters 1983; McKibben 1993), Salton Sea Trough (Muffler and Doe 1968), Salton Sink (Mendenhall 1909a,b; Kennan 1917; Threet 1978), Salton Basin (Buwalda and Stanton 1930; Wilke 1980; Gobalet 1992, 1994), Salton Sea Basin (Stanley 1962), Cahuilla Basin (Blake 1914**;** Free 1914: MacDougal 1914), Imperial Basin (Rigsby 1984; Dibblee 1984), or Imperial Depression (Longwell 1954). The Salton Trough Physiographic Province (Jahns 1954) is located between the Peninsular Range Physiographic Province on the west and the Basin and Range Physiographic Province on the east.

6.6.3.2 Regional Geologic Setting

The geology in the vicinity of the ECGS Site has been mapped or described by numerous workers, including Blake (1858), Mendenhall (1909b), Brown (1923), Dibblee (1954, 1984), Longwell (1954), Merriam and Bandy (1965), Van de Kamp (1973), Morton (1977), Crowell and Baca (1979), Sabins et al. (1980), Waters (1983), Rigsby (1984), and McKibben (1993), among others. Surficial geologic mapping of the Project Site and vicinity has been provided at a scale of 1:750,000 by Jennings (1977); at a scale of 1:500,000 by Jenkins (1938); at a scale of 1:250,000 by Brown (1923), Dibblee (1954), Strand (1962), Loeltz et al. (1975), and Kahle et al. (1984); and at a scale of 1:125,000 by Morton (1977). No larger scale (such as 1:62,500-scale or 1:24,000-scale) geologic maps are currently available for this area. The information in geologic maps and other published and unpublished reports form the basis of the following discussion. Individual maps and publications are incorporated into this report and referenced where appropriate. The aspects of geology pertinent to this report are the types, distribution, and age of sediments immediately underlying the Project study area and their probability of producing fossils during Project construction. The site-specific geology of the ECGS Site is discussed in Section 6.5, Geological Resources and Hazards.

The Salton Trough is a rift valley formed by late Cenozoic extension, which also formed the Gulf of California to the south. As the rift valley formed, sediments deposited primarily by the Colorado River gradually filled the trough and depositional environments changed over time from marine, to deltaic, to subaerial river and lake deposits. During Quaternary time, the central portion of the Salton Trough was periodically covered by lakes. The most recent of these ancient lakes was known as Lake Cahuilla. Today, the Mesozoic-age crystalline basement rocks from which the rift valley formed are covered by about 15,000 feet of Cenozoic marine and nonmarine sedimentary deposits (Geotechnics 2006).

Late Cenozoic alluvial deposits accumulated in the Imperial Valley consist of a thick sequence of medium- to fine-grained sediment deposited by the Colorado River and local streams, which drain off the foothills of the surrounding mountain ranges (Crowell and Baca 1979). These deposits generally grade basin-ward through gradually decreasing grain sizes from coarse pebble to cobble gravel in the foothills to clay-rich silt on the floor of the Imperial Valley. The fine sands, silts, and clays that compose the lacustrine deposits near the center of the Imperial Valley have in the past produced abundant fossils, primarily invertebrates, fishes, birds, and large and small land mammals. These paleontological resources are discussed below.

Geological materials composing this thick sediment accumulation have been subdivided into stratigraphic units based on differences in lithology and age. In the immediate Project vicinity, sediments composing the Colorado River alluvial fan and delta have been divided into four stratigraphic units, from oldest to youngest: weakly cemented siltstone, sandstone, and conglomerate of the marine Pliocene Imperial Formation; finer grained sediments of the mixed marine and nonmarine Early Pleistocene Borrego Formation; a slightly younger (Middle Pleistocene to Early Holocene) and less consolidated, but otherwise similar sedimentary sequence known as the Brawley Formation; and Late Pleistocene to Holocene sediments informally named the Lake Cahuilla Beds. Since they were derived from a common source and deposited in similar environments, the Borrego Formation, Brawley Formation, and Lake Cahuilla Beds are not easily distinguished from one another. The principal differences between the older and younger lacustrine sediments are stratigraphic position, degree of consolidation, topographic expression, attitude (tilted versus flat-lying), and fossil content. Neither the Imperial Formation nor Borrego Formation is present at or near the surface in the vicinity of the ECGS Site. Since they will not be impacted by Project construction, they will not be discussed further in this report.

The Quaternary alluvium on the Imperial Valley plain assigned to the Lake Cahuilla Beds is lithologically indistinct from the underlying Brawley Formation, but can be distinguished from it by stratigraphic position; degree of consolidation (and therefore topographic expression); and amount of deformation, age, and fossil content. Strata comprising the Brawley Formation have been deformed by tectonic activity related to movement on the San Andreas and related faults and can often be recognized from the overlying Lake Cahuilla Beds by their non-flat-lying attitude. The Brawley Formation is believed to be Pleistocene to possibly Early Holocene in age, while the age of the Lake Cahuilla Beds is probably entirely Holocene (although both Stanley [1962] and Thomas [1963] have presented evidence for a Pleistocene age for the oldest Lake Cahuilla Beds).

6.6.4 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the ECGS Site and surrounding area, and to assess the potential paleontological productivity of each stratigraphic unit present, the published as well as available unpublished geological and paleontological literature was reviewed, and stratigraphic and paleontologic inventories were compiled, synthesized, and evaluated (see below). These methods are consistent with CEC (2000) and SVP (1995) guidelines for assessing the importance of paleontological resources in areas of potential environmental effect. No subsurface exploration was conducted for this assessment. However, a geotechnical report of the ECGS Site (Geotechnics 2006) was very useful. Stratigraphy was observed in the banks of numerous irrigation ditches during field surveys on 14 December 2005 and 5 January 2006. Bore hole logs describing the subsurface stratigraphy are provided by Geotechnics (2006) and a short stratigraphic section of sediments exposed during construction of ECGS Unit 2 is provided by Deméré (1992).

Geologic maps and reports covering the surface and subsurface geology of the Project Site and vicinity were reviewed to determine the exposed and subsurface rock units, to assess the potential paleontological productivity of each rock unit, and to delineate their respective areal distribution in the Project study area. In addition, available soil surveys and aerial photographs of the area were examined to aid in determining the areal distribution of distinctive sediment and soil types.

The number and locations of previously recorded fossil sites from rock units exposed in and near the Project Site and the types of fossil remains each rock unit has produced in the past were evaluated based on published and unpublished geological and paleontological literature (including previous environmental impact assessment documents and paleontological resource impact mitigation program final reports). Especially helpful were previous surveys of Quaternary land mammal fossils of California made by Hay (1927), Lundelius et al. (1983), and Jefferson (1991a), and surveys of Quaternary birds, reptiles, and amphibians made by Miller and DeMay (1953) and Jefferson (1991b). The literature review was supplemented by archival searches conducted at the San Diego Natural History Museum (SDNHM) and University of California Museum of Paleontology (UCMP) in Berkeley, for additional information regarding the occurrence of fossil sites and remains in and near the Project Site.

Field surveys, which included a visual inspection of exposures of potentially fossiliferous strata in the Project study area, were conducted to document the presence of sediments suitable for containing fossil remains and the presence of any previously unrecorded fossil sites. The field surveys for this assessment were conducted on 14 December 2005 by both Lanny H. Fisk, PhD, PG and Patrick W. Riseley, MSc, PG, Field Geologist and Junior Paleontologist with PRC and again on 5 January 2006 by Mr. Riseley.

In common with other environmental disciplines such as biological resources (specifically in regard to threatened and endangered species) and cultural resources, following CEQA and SVP (1995), paleontologists consider all fossil specimens significant, unless demonstrated otherwise, and, therefore, protected by environmental statutes. This position is held because fossils are uncommon and only rarely will a fossil locality yield a statistically significant number of specimens representing the same species. In fact, vertebrate fossils are so uncommon that, in most cases, each fossil specimen found provides additional important information about the characteristics or distribution of the species it represents.

A stratigraphic unit (such as a formation, member, or bed) known to contain significant fossils is considered to be "sensitive" to adverse impacts if there is a probability that earth-moving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains. This definition of sensitivity differs fundamentally from that for archaeological resources:

> *It is extremely important to distinguish between archaeological and paleontological (fossil) resource sites when defining the sensitivity of rock units. The boundaries of archaeological sites define the areal extent of the resource. Paleontologic sites, however, indicate that the containing sedimentary rock unit or formation is fossiliferous. The limits of the entire rock formation, both areal and stratigraphic, therefore define the scope of the paleontologic potential in each case.* (SVP 1995)

This distinction between archaeological and paleontological sites is important. Most archaeological sites have a surface expression that allow for their geographic location. Fossils, on the other hand, are an integral component of the rock unit below the ground surface, and, therefore, are not observable unless exposed by erosion or human activity. Thus, a paleontologist cannot know either the quality or quantity of fossils present before the rock unit is exposed as a result of natural erosion processes or earth-moving activities. The paleontologist can only make conclusions on sensitivity to impact based upon what fossils have been found in that rock unit in the past, along with a judgment on whether or not the depositional environment of the sediments that compose the rock unit was likely to result in the burial and preservation of fossils.

Fossils are seldom uniformly distributed within a rock unit. Most of a rock unit may lack fossils, but at other locations within the same rock unit concentrations of fossils may exist. Even within a fossiliferous portion of the rock unit, fossils may occur in local concentrations. For example, Shipman (1977, 1981) excavated a fossiliferous site using a three dimensional (3D) grid and removed blocks of matrix of a consistent size. The site chosen was known prior to excavation to be richly fossiliferous, yet only 17% of the blocks actually contained fossils. These studies demonstrate the physical basis for the difficulty in predicting the location and quantity of fossils in advance of project-related ground disturbance.

Since it is unfortunately not possible to determine where fossils are located without actually disturbing a rock unit, monitoring of excavation by an experienced paleontologist during construction increases the probability that fossils will be discovered and preserved. Preconstruction mitigation measures such as surface prospecting and collecting will not prevent adverse impacts on fossils because many sites will be unknown in advance due to an absence of fossils at the surface.

The non-uniform distribution of fossils within a rock unit is essentially universal and many paleontological resource assessment and mitigation reports conducted in support of environmental impact documents and mitigation plan summary reports document similar findings (see for instance Lander [1989, 1993], Reynolds [1987, 1990], Spencer [1990], Fisk et al. [1994], and references cited therein). In fact, most fossil sites recorded in reports of impact mitigation (where construction monitoring has been implemented) had no previous surface expression. Because the presence or location of fossils within a rock unit cannot be known without exposure resulting from erosion or excavation, under SVP (1995) standard guidelines, an entire rock unit is assigned the same level of sensitivity based on previously recorded fossil occurrences.

Using SVP (1995) criteria, the paleontological potential or sensitivity (high, low, or undetermined) of each rock unit exposed in a project site or surrounding area is the measure most amenable to assessing the significance of paleontological resources because the areal distribution of each rock unit can be delineated on a topographic or geologic map. The paleontological importance of a stratigraphic unit reflects: (1) its potential paleontological productivity (and thus sensitivity) and (2) the scientific significance of the fossils it has produced. This method of paleontological resources assessment is the most appropriate because discrete levels of paleontological importance can be delineated on a topographic or geologic map.

The potential paleontological productivity of a stratigraphic unit exposed in a project study area is based on the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near a project site. The underlying assumption of this assessment method is that exposures of a stratigraphic unit are most likely to yield fossil remains both in quantity and density similar to those previously recorded from that stratigraphic unit in and near the Project Site.

A paleontological resource can be significant if:

- It provides important information on the evolutionary trends among organisms, relating living organisms to extinct organisms.
- It provides important information regarding development of biological communities or interaction between botanical and zoological biota.
- It demonstrates unusual circumstances in biotic history.
- It is in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and is not found in other geographic localities.

Under CEQA guidelines (PRC 15064.5 [a] [2]), public agencies must treat all historical and cultural resources as significant unless the preponderance of evidence demonstrates that they are <u>not</u> historically or culturally significant. Paleontological resources are included in CEQA with cultural resources. In keeping with significance criteria of the SVP (1995), all vertebrate fossils are categorized as having significant scientific value.

Individual fossil specimens are considered scientifically important if they are:

- Identifiable
- Complete
- Well preserved
- Age diagnostic
- Useful in paleoenvironmental reconstruction
- A type or topotypic specimen
- A member of a rare species
- A species that is part of a diverse assemblage
- A skeletal element different from, or a specimen more complete than, those now available for that species

Identifiable land mammal fossils are considered scientifically important because of their potential use in providing accurate age determinations and paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Although fossil plants are usually considered of lesser importance because they are less helpful in age determination, they are actually more sensitive indicators of their environment and, thus, as sedentary organisms, more valuable than mobile animals for paleoenvironmental reconstructions. For marine sediments, invertebrate and marine algal fossils, including microfossils, are scientifically important for the same reasons that land mammal and/or land plant fossils are valuable in terrestrial deposits. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils.

The following tasks were completed to establish the paleontological importance and sensitivity of each stratigraphic unit exposed in or near the Project Site:

- The potential paleontological productivity of each rock unit was assessed based on the density of fossil remains and/or previously recorded and newly documented fossil sites it contains in and/or near the Project Site.
- The scientific importance of fossil remains recorded from a stratigraphic unit exposed in the Project Site was assessed.
- The paleontological importance of a rock unit was assessed, based on its documented and/or potential fossil content in the area surrounding the Project Site.

Categories of Sensitivity

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined.

- **High Sensitivity.** Stratigraphic units in which fossils have been previously found have a high potential to produce additional fossils and are therefore considered to be highly sensitive. In areas of high sensitivity, full-time monitoring is recommended during any project-related ground disturbance.
- **Low Sensitivity.** Stratigraphic units that are not sedimentary in origin or that have not been known to produce fossils in the past are considered to have low sensitivity. Monitoring is usually not recommended nor needed during project construction through a stratigraphic unit with low sensitivity.
- **Undetermined Sensitivity.** Stratigraphic units that have not had any previous paleontological resource surveys or any fossil finds are considered to have undetermined sensitivity. After reconnaissance surveys, observation of artificial exposures (such as road cuts) and natural exposures (such as stream banks), and possible subsurface testing (such as augering or trenching), an experienced, professional paleontologist can often determine whether the stratigraphic unit should be categorized as having high or low sensitivity. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are categorized as having significant scientific value and all stratigraphic units in which vertebrate fossils have previously been found have high sensitivity.

6.6.5 Resource Inventory Results

6.6.5.1 Stratigraphic Inventory

Regional geologic mapping of the ECGS Site and vicinity has been provided by Blake (1858; approximately 1:2,000,000), Jennings (1977; 1:750,000 scale), Jenkins (1938; 1:500,000 scale), Brown (1923, 1:250,000 scale), Dibblee (1954, 1:250,000 scale), Strand (1962, 1:250,000 scale), Loeltz et al. (1975, 1:250,000 scale), Kahle et al. (1984, 1:250,000 scale), and Morton (1977, 1:125,000). No larger scale mapping of the Project Site is available. Unfortunately, in their geologic maps of the Late Cenozoic deposits of the Project study area, these geologists have not always used formally named stratigraphic units; nor have they consistently used the same map units.

Blake (1858) mapped the pre-Salton Sea "Valley of the Ancient Lake" simply as alluvium and specified that the alluvium consisted of lacustrine clay of the Colorado Desert. Brown (1923) mapped the ECGS Site and vicinity simply as unconsolidated alluvium consisting of silt, sand, and conglomerate. Strand (1962) mapped the area in the vicinity the ECGS Site as "Quaternary lake deposits," which he defined as "Lake Coahuila [sic] deposits." Loeltz et al. (1975) showed the Project Site and surrounding Imperial Valley flood plain underlain by Pleistocene and Holocene "Lake deposits," which they stated included "the Brawley Formation exposed along the perimeter of the trough and deposits of Lake Cahuilla in the middle of the trough." Morton (1977) mapped the ECGS Site and Imperial Valley flood plain as Quaternary "Lake beds," which he recognized as "sediments of ancient Lake Cahuilla." These previous interpretations of the geology in the vicinity of the Project Site are supported by soil surveys (Zimmerman 1981).

6.6.5.2 *Site Geology*

Geologic mapping by Brown (1923), Dibblee (1954), Strand (1962), Loeltz et al. (1975), Morton (1977), and Kahle et al. (1984) indicate that the ECGS Site is underlain by lacustrine deposits referred to informally as the Lake Cahuilla Beds overlying deposits referable to the Brawley Formation. In the immediate Project vicinity, the younger Cahuilla Lake Beds form a relatively thin sedimentary deposit over the older Brawley Formation. Thus, although the Cahuilla Lake Beds are mapped as being present at the surface over the entire Project study area, the older Brawley Formation may still be encountered in deep excavations. However, due to the similarity in lithology, the depth at which sediments of the Brawley Formation will be encountered is uncertain. Deméré (1992) reported a significant change in lithology at a depth of approximately 6 feet bgs in excavations for the ECGS Unit 2. This gradational contact could represent the contact between the Lake Cahuilla Beds and the Brawley Formation. Sediments of both these formations have yielded fossilized remains of continental vertebrates, invertebrates, and plants at numerous previously recorded fossil sites in the Imperial Valley (see discussion below).

Lake Cahuilla Beds

The Lake Cahuilla Beds were first named by Blake (1854, 1907). They consist of interbedded reddish-brown to gray, unconsolidated silty clays, silts, and fine sands deposited in prehistoric Lake Cahuilla. Whistler et al. (1995) placed the age of the Lake Cahuilla Beds between 6,000 and 300 years BP, Middle to Late Holocene. However, both Stanley (1962) and Thomas (1963) independently suggested that the oldest sediments deposited in Lake Cahuilla may be Late Pleistocene, older than about 10,000 years BP. Fossils from a Lake Cahuilla shoreline yielded a Late Pleistocene radiocarbon date of 37,100 ± 2,000 years BP (Hubbs et al. 1963). The youngest Lake Cahuilla sediments may have been deposited as recently as 300 years ago (Elders 1979).

Brawley Formation

The Brawley Formation was named and described by Dibblee (1954). The Brawley Formation is typically composed of interbedded reddish-brown to gray, poorly sorted, clayey silts and fine sands. Strand (1962) described the Brawley Formation in the El Centro area as “light-gray lacustrine clays, buff sandstones, and pebble conglomerates.” Locally these sediments are weakly cemented with calcareous and/or hematite cements, but in other nearby locations they are uncemented. These beds are primarily lacustrine (lake) or fluvial (stream) deposits. The Brawley Formation is Pleistocene in age based on stratigraphic superposition and age-diagnostic fossils. However, some geologists have suggested that the youngest Brawley Formation may be Early Holocene in age.

6.6.5.3 Paleontological Resource Inventory

An inventory of the paleontological resources of each stratigraphic unit potentially present at the Project Site is presented below and the paleontological importance of these resources is assessed. The literature review and SDNHM and UCMP museum archival record searches conducted for this inventory documented no previously recorded fossil sites within the very limited footprint of the Project Site. However, one previously recorded fossil site is documented immediately adjacent to the Project Site and numerous fossil localities have been reported from sediments referable to the Lake Cahuilla Beds and Brawley Formation in the general vicinity of the ECGS Site. In addition, fossil remains were found at a previously unrecorded fossil site during the field survey of the Project Site and vicinity conducted for this assessment.

Lake Cahuilla Beds

The Lake Cahuilla Beds have yielded fossil remains at numerous sites in the Imperial Valley. Blake (1907) stated that the sediments of ancient Lake Cahuilla contained “myriads of fossil fresh-water shells.” Stearns (1879) used language such as “vast multitude” and “untold millions” in reference to Lake Cahuilla fossil invertebrates. Jennings (1967) stated that the Lake Cahuilla deposits “contain abundant nonmarine fossils.” In addition to invertebrates (primarily snails, clams, and ostracods), these fossil remains include petrified wood (Stanley 1962; Van de Kamp 1973; Whistler et al. 1995), plants (Conkling 1994), seeds (Waters 1983), pollen (Whistler et al. 1995), diatoms (Whistler et al. 1995), foraminifera (Van de Kamp 1973), sponges (Whistler et al. 1995), fish (Hubbs and Miller 1948; Gobalet 1992, 1994; Conkling 1994; Wilke 1980; Schoenherr 1993; Whistler et al. 1995; Deméré 1992), birds (Whistler et al. 1995), and the bones and teeth of a diversity of land mammals (Whistler et al. 1995), including rodents, rabbits, reptiles (tortoises, lizards, and snakes), horses, and desert bighorn sheep.

During excavations for construction of ECGS Unit 2, paleontological monitors with PaleoServices, Inc. (Deméré 1992) discovered “possible plant debris;” four species of freshwater snails (*Tryonia protea*, *Physa* sp. cf. *P. humerosa*, *Planorbella tenuis*, and *Amnicola* sp.); a freshwater clam (*Anodonta californiensis*); ostracodes (cf. Candonidae); the bones and teeth of one species of cyprinid fish (the bonytail, *Gila elegans*); and a single tooth and bone tentatively referred to a small cricetid rodent (deer mouse, *Peromyscus* sp.). Because the age of these specimens is uncertain, Deméré (1992) referred to them as “fossil” or “subfossil,” the latter term usually meaning younger than about 5,000 radiocarbon years (SVP 1995). These specimens were collected from foundation excavations approximately 3 feet bgs and are designated San Diego Society of Natural History (SDSNH) Locality 3650. Additional snail shells were collected down to the maximum depth of excavations at 7 feet (Deméré 1992). Shells from the deepest depth could possibly be from the Pleistocene Brawley Formation (see discussion below).

In summary, sediments referable to the Lake Cahuilla Beds have yielded scientifically significant fossils in the past and during the field survey for this impact assessment. Several previously unrecorded fossil localities were found less than 1 mile from the Project Site. There is a high potential for further fossil remains to be uncovered by excavations in Lake Cahuilla Beds at the Project Site. Because this stratigraphic unit in the past has produced significant fossils, under SVP (1995) criteria the Lake Cahuilla Beds are judged to have high sensitivity. Additional identifiable fossil remains recovered from the Lake Cahuilla Beds during Project construction could be scientifically important and significant.

Brawley Formation

Fossils have also been previously reported from Brawley Formation sediments at numerous scattered locations. Fossils previously reported from the Brawley Formation include ostracods, foraminifera, snails, clams, fish, horses, other unidentified large mammals, and land plant remains (Deméré 1992; Fisk 2002, 2006). Herzig and Mehegan (1987) reported gastropods and ostracods in cuttings from the State 2-14 well from sediments at shallow depths that are probably Brawley Formation. The UCMP has two vertebrate fossil localities and one invertebrate fossil locality in Pleistocene sediments referable to the Brawley Formation in Imperial County. The locality closest to El Centro is UCMP Locality V-5931 (Seeley West) located in the east bank of the New River approximately 7 miles due west of El Centro and 0.75 mile west of the community of Seeley. This locality produced Pleistocene land mammal fossils from a depth of 6 to 8 feet bgs in sediments presumably of the Brawley Formation. Although they are some distance away from the Project Site, these fossils are significant because they indicate that vertebrate fossil-bearing Pleistocene sediments are present at a shallow depth in the center of the Imperial Valley and, thus, also could be found in relatively shallow excavations underlying the Project Site.

During the field survey of prospective fossiliferous sediments near the Project Site on 14 December 2005 and 5 January 2006, Dr. Fisk and Mr. Riseley found a paleosol (fossil soil) containing fossil plant remains, root and burrow casts and molds (known as ichnofossils), and tiny freshwater snails (microgastropods) in Brawley Formation sediments in the banks of an irrigation ditch along the west border of the ECGS property. At this locality, the banks of the canal expose 12 feet of stratigraphic section. Sediments from 1 to 5 feet bgs are artificial fill. From 5 to 7 feet bgs, sediments consist of well-bedded and in part laminated, reddish brown silty clay, which we interpret as Lake Cahuilla Beds. At a depth of 7 feet bgs, the lithology changes to massive, brown silty-sandy clay. The fossils occur in the latter stratigraphic unit, which we tentatively correlate with the Pleistocene Brawley Formation. This interpretation is supported by the presence of Pleistocene land mammal fossils at a depth of 6 to 8 feet bgs at the UCMP West Seeley locality discussed above. The stratigraphy exposed in the banks of the irrigation canal is very similar to that described by Deméré (1992) in excavations for construction of ECGS Unit 2. Deméré reported a lithologic change at a depth of 6 feet bgs from predominately reddish-brown, faintly laminated to massive mudstone above to reddish-brown, massive clayey siltstone below. As mentioned above, this lithologic change is interpreted as the top of the Pleistocene Brawley Formation. Deméré (1992) reported microgastropods both above and below this lithologic break.

The paleosol and fossil invertebrate and plant remains from the Brawley Formation are scientifically significant because paleontological data derived from a study of these fossil remains, in conjunction with geologic (particularly geochronologic, sedimentologic, and paleomagnetic) evidence, could be significant in documenting the origin and age of the Brawley Formation and in reconstructing the Pleistocene geologic and paleobiologic history of the Imperial Valley area.

Since significant fossils have been previously reported from the Brawley Formation and since depositional conditions in the vicinity of the Project Site appear to be favorable for the preservation of fossils, this formation is judged to also have high sensitivity. There is a high probability that ground disturbance in sediments of the Brawley Formation during Project construction may impact additional paleontological resources. Additional identifiable fossil remains recovered from the Brawley Formation during Project construction could be scientifically important and significant.

6.6.5.4 Summary

Fossils are known to be present in sediments underlying the ECGS Unit 2 immediately adjacent to the Project Site (Deméré 1992) and in the banks of an irrigation canal immediately to the west of the ECGS Site. The presence of these fossils in deposits of the Cahuilla Lake Beds and possibly Brawley Formation suggests that there is a high potential for additional similar fossil remains to be uncovered by excavations in these formations during Project construction. Under SVP (1995) criteria, both these formations have a high sensitivity for producing additional paleontological resources. Identifiable fossil remains recovered from either formation during Project construction could be scientifically important and significant.

Identifiable fossil remains recovered during Project construction could represent new taxa or new fossil records for the area, for the State of California, or for the Formation. They could also represent geographic or temporal range extensions. Moreover, discovered fossil remains could make it possible to more accurately determine the age, paleoclimate, and depositional environment of the sediments from which they are recovered. Finally, fossil remains recovered during Project construction could provide a more comprehensive documentation of the diversity of animal and plant life that once existed in Imperial County and could result in a more accurate reconstruction of the geologic and paleobiologic history of the Imperial Valley.

6.6.6 Impacts

Potential impacts on paleontological resources resulting from construction of the Project can be divided into construction-related impacts and operation-related impacts. Construction-related impacts to paleontological resources primarily involve terrain modification (excavations and drainage diversion measures). Paleontologic resources, including an undetermined number of fossil remains and unrecorded fossil sites; associated specimen data and corresponding geologic and geographic site data; and the fossil-bearing strata, could be adversely affected by ground disturbance and earth moving associated with construction of the Project. Direct impacts could result from grading the Project Site and Temporary Construction Area, trenching for pipelines, augering for foundations for electrical towers or poles, and any other earth-moving activity that disturbs or buries previously undisturbed fossiliferous sediments, making these sediments and their paleontologic resources unavailable for future scientific investigation. The potential environmental effects from construction and operation of the Project on paleontological resources are presented in the following subsections.

6.6.6.1 Potential Impacts from Project Construction

The Project Site is located on Holocene-age deposits of the fossiliferous Lake Cahuilla Beds which overly at a shallow depth fossiliferous sediments of the Pleistocene Brawley Formation. Deep excavation at the Project Site could result in significant adverse impacts to paleontological resources. No impacts on paleontological resources are expected to occur from the minimal ground disturbance associated with the Temporary Construction Area on the north side of East Villa Avenue.

6.6.6.2 Potential Impacts from Project Operation

No impacts on paleontological resources are expected to occur from the continuing operation of the Project or any of its related facilities.

6.6.7 Mitigation

This section describes Applicant-proposed mitigation measures that would be implemented to reduce potential adverse impacts to significant paleontological resources resulting from Project construction. These paleontological resource impact mitigation measures would reduce to an insignificant level the direct, indirect, and cumulative adverse environmental impacts on paleontological resources that might result from Project construction. The mitigation measures proposed below are in compliance with CEC environmental guidelines (CEC 2000) and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP 1995, 1996).

PALEO-1 Paleontological Monitoring. Prior to construction, a qualified paleontologist will be retained to both design and implement a monitoring and mitigation program. During construction, ground-disturbing activities will be monitored where these activities will potentially disturb previously undisturbed sediment. Monitoring will not be conducted in areas where the ground has been previously disturbed or in areas where exposed sediment will be buried, but not otherwise disturbed. Construction monitoring will be conducted to ensure that unanticipated discoveries are addressed in a timely manner.

PALEO-2 Paleontological Monitoring and Mitigation Program. The paleontological resource monitoring and mitigation program will include preconstruction coordination; construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; preparation, identification, analysis, and museum curation of any fossil specimens and data recovered; and reporting. This monitoring and mitigation plan will be consistent with SVP (1995) standard guidelines for the mitigation of construction-related adverse impacts on paleontological resources, as well as the requirements of the designated museum repository for any fossils collected (SVP 1996).

PALEO-3 Construction Personnel Education. Prior to start of Project construction, all personnel who will be involved with earth-moving activities will be informed that fossils may be encountered, on the appearance of common fossils, and on proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist.

Scientific recovery, preparation, identification, determination of significance, and curation into a public museum is considered by most land management agencies and by the SVP (1995) to adequately mitigate impacts to paleontological resources in most circumstances. Therefore, the implementation of these mitigation measures would reduce the potentially significant adverse environmental impact of project-related ground disturbance and earth moving on paleontological resources to an insignificant level by allowing for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data that otherwise would be lost to earth moving and to unauthorized fossil collecting. With a well designed and implemented paleontological resource monitoring and mitigation plan, Project construction could actually result in beneficial impacts on paleontological resources through the possible discovery of fossil remains that would not have been exposed without Project construction and, therefore, would not have been available for study. The identification and analysis of fossil remains discovered as part of Project construction could help answer important questions regarding the geographic distribution, stratigraphic position, tectonic history, and age of fossiliferous sediments in the Project study area.

6.6.8 Potential Unavoidable Adverse Impacts

Potential impacts on paleontological resources as a result of Project construction represent potential unavoidable adverse impacts as defined by CEQA and consequently will be mitigated to a level of below significance by the Project.

6.6.9 Cumulative Impacts

If the Project were to encounter paleontological finds during construction, the potential cumulative effect would be low, as long as mitigation measures were implemented to recover the resources. The mitigation measures proposed in Section 6.6.7, Mitigation, would effectively recover the value to science of any significant fossils unearthed during Project construction.

6.6.10 Involved Agencies and Agency Contacts

There are no state or local agencies having specific jurisdiction over paleontological resources on either state or privately owned land.

6.6.11 Permits Required and Permit Schedule

No state or county agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on state or private land. Removal of paleontological resources from federal lands requires a Paleontological Resource Use Permit from BLM. If federally owned or managed lands will be impacted by this Project, the paleontologist hired to manage the paleontological resource monitoring and mitigation program will need to have a current Paleontological Resource Use Permit, as well as fieldwork authorization from the local BLM office.

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